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BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

REPORT OF THE SURVEYS OF THE MOUNTAIN
PINE BEETLE INFESTATION ON THE
BEAVERHEAD NATIONAL FOREST
1935

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MISSOULA
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INTRODUCTION

Although no detailed survey was made of the mountain pine beetle infestation on the Beaverhead National Forest in 1935, it is believed sufficient data were secured to furnish an index of conditions. Circumstances did not permit a survey of the Sheep Canyon Hills south of Dillon, Montana, or of the nearby Blacktail Creek drainage. No general examination of the outbreak further east on the Gallatin Forest was projected in 1935, but it was planned to watch the progress of that infestation by surveying the entire Tobacco Root Range and by the establishment of a check strip on the northern part of the main Gallatin Forest on the Gallatin River drainage.

THE PRESENT STATUS OF THE
BEAVERHEAD INFESTATION

In 1933 a decided reduction occurred in the mountain pine beetle infestation on the main portion of the Beaverhead National Forest. A slight decrease was expected, owing to a shortage of host material in the area adjoining the Big Hole Basin, but the major portion of the decline can be credited to two extremely cold waves which occurred in December and February of 1932-33. In 1934 a slight increase occurred in the number of attacked trees on the units in the eastern part of the forest

where there was still an abundance of favorable host material, but the western units continued to show a decline in number of trees attacked. An increase in infestation was expected on the eastern units in 1935, as there was still ample acceptable host material, but again a severe cold spell which occurred in January of the winter of 1934-35 is believed to have been the major factor in a decided reduction in 1935. With no large body of mountain pine beetle infestation adjoining the Melrose, Grasshopper, and Rattlesnake Units, it seems unlikely that the outbreak on these three units will ever build up sufficiently to cause as heavy losses as it did in the area around the Big Hole Basin. A further possible inhibiting factor to increase in the outbreak is the large quantity of secondary insects present on the units. Since 1933 they have been "filling-in" mountain pine beetle-attacked trees in such large numbers as to probably prevent the development of much of the brood of the primary insect by consuming the cambium or rendering it unfit for food through desiccation. In addition, either greater hardiness to cold or warmer places of hibernation seem to have prevented the destruction of the overwintering brood of the secondary insects, thus still further increasing their ratio to the remaining mountain pine beetle brood and to lodgepole pine attacked the current year by the mountain pine beetle, which is the secondary insect's preferred host material. Under such adverse conditions only a small proportion of the mountain pine beetle brood can mature, and secondary insects, because of insufficient host material furnished them by the decreased number of primary insects, are forced into green trees. If the present ratio of secondary to primary insects persists,

it seems possible that secondary insects will be a major factor in controlling the infestation on the Grasshopper, Rattlesnake, and Melrose Units.

The status of the general infestation for the period of the surveys is as follows:

CHANGES IN MOUNTAIN PINE BEETLE INFESTATION
BEAVERHEAD NATIONAL FOREST

Number of Attacks in								
1927	1928	1929	1930	1931	1932	1933	1934	1935
67,691*	722,504	3,119,542	4,898,326	15,402,520	17,586,171	869,647	1,282,510	255,632
Increase	654,813	2,397,038	1,778,784	10,504,194	2,183,651		412,863	
Decrease						16,716,524		1,026,878

*Estimate considered to have been too conservative; also 55,045 of these trees were treated in 1928.

All data subsequent to 1927 corrected for effect of difference in date of survey on total infestation.

The data in the preceding tabulation indicate that the outbreak is at its lowest ebb since 1927, with only the eastern units of the forest now supporting any mountain pine beetle infestation.

Table I is a summarization of losses on each unit. Only the total of attacked trees is shown for the period from 1927 to 1930 and annual losses subsequent to that time.

TABLE I
SUMMARY SHEET - BEAVERHEAD FOREST SURVEY - 1935
COMPARISON OF INFESTATION FROM 1927-1935 CAUSED BY THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE

Unit	Acreage	1927-30	1931	1932	1933	1934	1935
Pintlar	61,600	1,050,379	762,485	667,732	37,167	10,651	None
Mussigbrod	56,300	1,150,910	1,336,675	1,424,904	12,085	7,848	None
Battlefield	102,400	2,514,804	4,445,696	2,471,203	37,895	8,179	None
West Side	76,500	963,165	2,031,534	1,468,693	52,129	25,574	None
Jackson	75,800	976,351	1,404,498	1,730,767	51,279	16,191	None
Bloody Dick	108,160	569,470	1,551,339	2,796,036	55,603	34,744	Not over 15,000
Horse Prairie	57,000	248,653	167,124	93,525	32,092	33,425	Not over 9,000
Rattlesnake	68,400	29,431	117,990	513,334	63,915	220,487	63,270
Grasshopper	42,500	18,646	91,587	574,034	12,455	52,395	18,870
Warm Springs	54,500	245,376	1,135,856	1,736,678	42,241	63,310	Not over 11,500
East Side	86,200	824,789	1,519,783	660,867	13,403	13,298	None
Upper Wise River	142,800	60,578	408,694	1,166,162	150,316	243,945	24,990
Lower Wise River	59,000	106,746	231,068	893,323	133,578	134,856	10,325
Melrose	132,700	10,368	134,847	1,182,491	110,919	391,757	95,677
Lima	218,000	27,751	63,344	206,422	64,570	25,850	Not over 7,000
Totals	1,341,860	8,795,417	15,402,326	17,586,171	869,647	1,282,510	255,632

Study of Table I indicates that only nine of the fifteen units now support any infestation. Three of the nine infested units contain 70 percent of the total number of trees attacked by the mountain pine beetle in 1935, and only those three areas have sufficient host material to support a possible future increase in the infestation.

In order to show the loss per average acre for each unit, Table II has been prepared.

TABLE II
COMPARISON OF ATTACKED TREES PER ACRE AND PERCENT OF INCREASE EACH YEAR FOR PERIOD 1927-1935
BEAVERHEAD FOREST SURVEY OF MOUNTAIN PINE BEETLE IN LODGEPOLE PINE -- 1935

	:1927-1930:		1931		1932		1933		1934		1935		
	:Total Att:		Att. :	% Change:	Att. :	% Change:	Att. :	% Change:	Att. :	% Change:	Att. :	% Change:	Total Trees
	:Trees per:		Trees:	over :	Trees:	over :	Trees:	over :	Trees:	over :	Trees:	over :	killed per
Unit	: Acre	: Per A:	prev.yr.:	Per A:	prev.yr.:	Per A:	prev.yr.:	Per A:	prev.yr.:	per A:	prev.yr.:	per A:	acre by DM
Pintlar	: 17.40	: 12.38:	70.4	: 10.08:	-18.5	: .60:	-94.0	: .17:	-71.3	: :	:	:	40.64
Mussigbrod	: 20.83	: 23.74:	152.8	: 25.32:	6.7	: .22:	-99.2	: .14:	-35.1	: :	:	:	70.25
Battlefield	: 24.60	: 43.42:	153.3	: 24.13:	-44.4	: .37:	-98.5	: .08:	-78.4	: :	:	:	92.60
West Side	: 12.59	: 26.56:	279.9	: 19.21:	-27.7	: .68:	-96.5	: .33:	-50.9	: :	:	:	59.37
Jackson	: 12.95	: 18.52:	150.8	: 22.84:	23.3	: .68:	-97.0	: .21:	-68.4	: :	:	:	55.19
Bloody Dick	: 5.27	: 14.34:	360.2	: 25.85:	80.3	: .51:	-98.0	: .32:	-37.5	: .14:	-56.3	:	46.44
Horse Prairie	: 4.36	: 2.93:	387.9	: 1.64:	-44.0	: .56:	-65.7	: .59:	4.1	: .16:	-66.1	:	10.25
Rattlesnake	: .43	: 1.72:	1301.6	: 7.50:	335.3	: .93:	-87.6	: 3.22:	245.0	: .93:	-71.2	:	14.75
Grasshopper	: .42	: 2.16:	545.2	: 13.52:	527.4	: .34:	-97.5	: 1.23:	320.7	: .44:	-64.2	:	18.11
Warm Springs	: 4.50	: 20.85:	793.8	: 31.88:	52.9	: .78:	-97.6	: 1.16:	49.9	: .21:	-21.9	:	59.38
East Side	: 9.75	: 17.63:	251.3	: 7.67:	-56.6	: .06:	-99.2	: .15:	-8	: :	:	:	35.26
Upper Wise River	: .42	: 2.86:	1406.3	: 8.17:	185.3	: 1.05:	-87.1:	: 1.71:	62.3	: .17:	-89.8	:	14.38
Lower Wise River	: 1.81	: 3.92:	236.4	: 15.13:	286.5	: 2.26:	-85.0	: 2.29:	1.0	: .17:	-82.8 -82.6	:	25.58
Melrose	: .08	: 1.02:	1203.8	: 8.91:	776.4	: .84:	-90.6	: 2.95:	253.2	: .72:	-75.6	:	14.52
Lima	: .13	: .29:	385.0	: .95:	225.4	: .30:	-68.7	: .12:	-60.0	: .03:	-75.0	:	1.81
Totals & Averages	: 6.60	: 11.48:	214.5	: 13.11:	14.2	: .65:	-95.1	: .96:	78.3	: .19:	-80.2	:	32.98

Big Hole Basin

On the basis of about $6\frac{1}{4}$ miles of strip survey on the Battlefield Unit, which contained 50 acres of timber, it was found that no infestation of the mountain pine beetle remained on that area and the light losses which were occurring were due entirely to secondary insects. Furthermore, the majority of these attacks were confined to the early summer and very few had occurred subsequent to that time, indicating that even these light losses were decreasing. Two of the total of twenty trees attacked were "fill-ins" of trees previously unsuccessfully attacked, and most of the remaining trees attacked had been weakened by porcupines, peridermium, mistletoe, snowbreak or windbreak. Removal of these defective trees and the thinning of overstocked stands are really beneficial, but even if considered as a loss it amounted to only .56 of a tree per acre. It is believed this figure and conditions on the Battlefield check strip are representative of insect activity on the units surrounding the entire Big Hole Basin exclusive of the eastern part of the Warm Springs Unit. There are 458,800 acres in this area, and using the loss data from the Battlefield check strip, we estimate 255,093 trees were killed by secondary insects in the Big Hole Basin in 1935. While the total loss seems high, it must again be emphasized that much of it was in defective timber and to that extent may be considered as largely beneficial. In addition, 90 percent of the trees attacked were less than five inches in diameter at breast height, showing that few of the larger poles were attacked.

Secondary bark beetles, including Pityogenes knechteli, Pityophthorus

burkei, Ips radiatae, Ips integer, and Ips oregoni have been causing an increasing proportion of the losses since 1933. In that year they are credited with the attack of 53 percent of the total trees killed by bark beetles; in 1934 with 85 percent; and in 1935 with 94.5 percent. On the Big Hole Basin drainage they were the only source of bark-beetle loss in 1935. In number of trees, they are estimated to have killed 988,558 in 1933, 7,383,098 in 1934, and 4,395,093 in 1935. It is noticeable that they did not kill as many trees in 1935 as in the preceding year, owing it is believed, to a decreasing supply of favorable host material. Still further reductions may be expected in 1936 owing to still further decreases in "ready-made" host material, which is the mountain pine beetle-attacked trees of the preceding and current years. When an insufficient supply of such food is available, the secondary insects are forced to attack green trees, and from previous experience it has been learned that secondary insects under such conditions are unable to cause serious losses for more than two or three years.

Although secondary insects are estimated to have killed more trees in the last three years than the mountain pine beetle during the same period, all their activity was not detrimental, as has been pointed out in a previous discussion. In some areas, in spite of the fact that healthy trees have been attacked, secondary-insect activity has been beneficial in that it has resulted in the thinning of overstocked stands.

In estimating the amount of infestation on units on the portion of the Beaverhead Forest immediately east and south of the Big Hole Basin, on

which no survey was made in 1935, the data from the surveyed Grasshopper, Rattlesnake, and Melrose Units were used. On these three units, the number of trees attacked by the mountain pine beetle in 1935 was estimated to be about 27% of the number similarly attacked last year. While it is known that the infestation on the Bloody Dick, Horse Prairie, Warm Springs, and Lima Units is in a more advanced stage and probably declining more rapidly than on the units from which data are available, it is impossible to measure the difference with any accuracy, so the available data are used even though they are probably too high.

Battlefield Check Strip

No mountain pine beetle-attacked trees were found on the Battlefield check strip in 1935 and losses from secondary insects were reduced to a negligible amount. Only 20 trees were attacked in 1935, all by secondary bark beetles, compared with 339 by the same agency in 1934. It seems quite likely that losses are now what may be considered normal or the average to be expected in a stand not subject to an active infestation.

To bring the data on losses from bark beetles on the Battlefield strip up to date, Table III has been prepared.

TABLE III
TREES ATTACKED ON THE BATTLEFIELD CHECK STRIP
BY BARK BEETLES UP TO AND INCLUDING 1935

	<u>Total</u>	<u>Per Acre</u>
Killed by <u>Dm.</u>	6,106	169.6
Killed by <u>Ips</u> sp.* & <u>Dm.</u>	903	27.9
Killed by <u>Ips</u> sp.	<u>1,386</u>	<u>38.5</u>
Total	8,395	236.0
Trees with green side following <u>Dm.</u> attack	724	20.1
Trees which have "Pitched-out" <u>Dm.</u> attacks	2,401	67.2
Trees which have "Pitched-out" <u>Ips</u> sp. attack	<u>17</u>	<u>.5</u>
Total	3,162	87.8
Grand Total	<u>11,537</u>	<u>323.8</u>

*Includes all secondary bark beetles in this and subsequent tables.

The heavy losses shown in the preceding table, which occurred during the course of the epidemic, while removing practically all the merchantable timber, still leave a heavy stand of small-diameter trees. Unfortunately, they are not equally distributed, stands of small trees still being overstocked with resulting retarding of growth, while mature stands of larger timber have been almost completely destroyed, leaving them decidedly understocked. There are indications, however, in the latter type of stand that ample stocking will be secured in a few years from seed in the ground.

Already the opening up of the stand has resulted in an increasing ground cover of seedlings in some areas.

The stand remaining on the Battlefield check strip is shown in Table IV. It includes all green trees above one inch in diameter breast high.

TABLE IV
BATTLEFIELD CHECK STRIP
STAND OF LODGEPOLE PINE PER ACRE
1935

DBH	2	4	6	8	10	12	14	16	18	20	22	Total	% ori-: ginal	Sq.ft.: ginal	% ori-: basal	Aver-: age
Classes	2	4	6	8	10	12	14	16	18	20	22	Total	stand	area	area	DBH
LP per Acre																
prior to in- festation	547.94	274.33	179.08	123.07	52.03	17.06	9.50	1.06	.81		.03	1,204.89	97.2	168.89	97.0	4.3
At end of '35:																
Green	538.83	244.16	72.47	24.28	4.67							884.42	71.4	58.31	33.5	3.1
Pitched-out	.14	.25	35.33	30.42	.89		.08					67.14	5.4	18.16	10.5	7.0
Other species:	18.25	7.23	3.36	2.67	1.37	.28	.25		.28	.25		33.94	2.8	5.12	3.0	4.1
Grand Total																
Living Trees																
per Acre	557.22	251.64	111.16	57.37	6.93	.28	.33		.28	.25		985.50	79.6	81.59	46.2	3.4

Timber losses on the Battlefield strip due to the mountain pine beetle have been confined in general to the lodgepole pine above five inches in diameter and to the very few western yellow pine, whitebark pine, and some of the Engelmann spruce. The unsusceptible portion of the stand includes most of the lodgepole pine below five inches in diameter breast high, Douglas fir, alpine fir, and most of the Engelmann spruce.

In studying the effect of a mountain pine beetle infestation on a lodgepole pine stand we find the losses mount with increase in diameter of the average tree. Areas of lodgepole pine less than three inches in diameter have been practically unaffected by the bark beetles. Where the original stand was of trees less than seven inches in diameter, usually enough remain to constitute a well-stocked stand. Stands which had a large proportion of timber over seven inches in diameter are likely to have too few remaining green trees to produce a normal stand of two hundred and fifty trees per acre at 140 years as suggested on page 31, D. T. Mason's United States Department of Agriculture, Bulletin 154. Mature and over-mature lodgepole pine stands have suffered an almost total loss, and their replacement must be from seeds already in the soil or from the few remaining green trees. The effect of a heavy loss of timber from bark-beetle activity is quite similar to a heavy cutting. From page 15 of Bulletin 154 we learn that within ten years following a fire or cutting about 90.5 percent of the reproduction has come in. Table II from the same bulletin indicates two hundred years are required to grow merchantable lodgepole pine averaging 11.2 inches in diameter with dominant trees measuring 14.7 inches,

so we may expect that much time to replace mature stands. The areas having only mature timber were few; however, usually the stand contained some younger trees which constituted a future merchantable stand when they were sufficiently numerous.

Prior to the infestation the susceptible trees over five inches in diameter breast high numbered 380 per acre, which the outbreak reduced to 101 undamaged and 68 "pitched-out" trees, the latter having overcome bark-beetle attacks. The "pitched-out" trees have, in general, been insufficiently damaged to prevent their growth into merchantable timber, but the 20 green-sided trees left per acre, which have more or less of the circumference of the bole killed, will probably be unmerchantable even should they live to maturity. The future merchantable stand therefore averages 169 trees per acre over five inches in diameter, and 6.7 inches in average diameter, exclusive of 244 trees per acre from five to three inches and 539 from three to one inch in diameter breast high. From the same bulletin we learn that the 169 trees average about ninety-five years of age and to reach 11.2 inches average diameter requires about one hundred more years. From the preceding discussion we may expect a maximum of two hundred years to be required to replace mature stands, and an average of one hundred years to restore the stand as a whole.

It is realized that acceleration of growth may result where stands are thinned, the amount depending somewhat upon the degree to which the stand has been opened up. From Table V of Bulletin 154 we find that 91 trees from 3 to 10 inches in diameter showed an average acceleration in

growth after thinning of about 6 percent. Such an increase in growth rate will not materially shorten the time required for maturity.

The stands on the Battlefield strip where little or no acceleration in growth may be expected are those containing trees under five inches in diameter in which insects have killed less than 5 percent of the total number.

Wise River Check Strip

Probably the major factor causing the decided reduction and light losses on this strip in 1935 was the cold spell during the winter of 1934-35. Secondary insects killed a total of 45 previously attacked, green trees, unsuccessfully attacked another, and were "pitched-out" of one more. In addition they "filled-in" the attack of the mountain pine beetle on six trees. The latter insect overcame one tree previously unsuccessfully attacked, attacked but failed to overcome a second, killed three green trees and one side of another.

There is a possibility that the data for this strip are not complete, as no examination was made subsequent to late August owing to adverse weather conditions late in the season. Complete data for the Elkhorn check strip showed 29 percent of the attacks by secondary insects and 62 percent of the mountain pine beetle attacks occurred subsequent to August 26th. However, as there may have been considerable difference in the activity of both the mountain pine beetle and secondary

insects on the two strips, no attempt has been made to apply a correction factor but the data have been worked up and presented as secured.

Table V gives the status of the susceptible timber up to the present time.

TABLE V
TREES ATTACKED ON THE WISE RIVER CHECK STRIP
BY BARK BEETLES UP TO AND INCLUDING 1935

	<u>Total</u>	<u>Per Acre</u>
Killed by <u>D.m.</u>	1,568	39.2
Killed by <u>Ips</u> & <u>D.m.</u>	269	6.7
Killed by <u>Ips</u> sp.	<u>501</u>	<u>12.5</u>
Total	2,338	58.4
Trees with green side following <u>D. m.</u> attack	1	.03
Trees which have "pitched-out" <u>D.M.</u> attack	136	3.4
Trees which have "pitched-out" <u>Ips</u> attack	<u>1</u>	<u>.02</u>
Total	138	3.5
Grand Total	<u>2,476</u>	<u>61.9</u>

Part of the Wise River check strip is located in the transition zone between the lower limits of the lodgepole pine type and the upper limits of the pure Douglas fir type. It was hoped that an indication of the effect of Douglas fir in mixture with lodgepole pine on losses due

to the mountain pine beetle might be secured on this strip. However, the infestation failed to maintain the impetus it had while sweeping over the western portion of the forest, and for that reason it is believed this strip will not give a fair indication of what effect the mixture of susceptible and unsusceptible trees will have upon final losses from a mountain pine beetle outbreak. It is believed, however, that the lodgepole pine-Douglas fir stands immediately west of the Big Hole Pass on the Salmon National Forest were in the portion of the region which was subjected to the outbreak when it was at the peak of its intensity, and a study made on that area should give a fair index of the effect of mixed timber species on losses due to insects.

In Table VI the losses which have occurred up to the present time and the amount of unsusceptible timber in the stand are shown.

TABLE VI
WISE RIVER CHECK STRIP
STAND OF LODGEPOLE PINE PER ACRE
1935

																	% ori-	Sq.ft.	% ori-	
																	ginal	basal	ginal	
DBH																	stand	area	basal	Average
Classes	2	4	6	8	10	12	14	16	18	20	22	24	26	Total			area	area	DBH	
LP per Acre	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
prior to in-	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
festation	:213.2	:176.4	:55.4	:46.8	:14.6	:10.6	:5.1	:.8	:.7	:	:	:	:	:523.0	:74.4	:70.9	:65.3	:	:4.2	:
At end of '35:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Green	:208.0	:172.0	:46.5	:28.3	:3.7	:.9	:.9	:.1	:.2	:	:	:	:	:460.6	:65.5	:42.7	:39.4	:	:3.6	:
Pitched-out	:	:.1	:.6	:1.4	:.4	:.4	:.02	:	:	:	:	:	:	:2.9	:.4	:1.4	:1.2	:	:8.2	:
Other species:	70.8	50.7	24.9	9.8	6.4	8.1	4.6	3.3	.7	.4	.2	.2	180.1	25.6	37.4	34.7	:	:4.9	:	:
Grand Total	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Living Trees	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Per Acre	:278.8	:222.8	:72.0	:39.5	:10.5	:9.4	:5.5	:3.4	:.9	:.4	:.2	:.2	:643.6	:91.5	:81.5	:75.4	:	:4.0	:	:

Elkhorn Check Strip

The heaviest losses for any of the three strips from insect activity in 1935 were observed on the Elkhorn check strip. Secondary insects killed the greatest number of trees, with the mountain pine beetle responsible for only 5 percent of the total loss. Up to the present time this strip has suffered the least total loss of the three check strips. The losses are shown in Table VII which follows.

TABLE VII
TREES ATTACKED ON THE ELKHORN CHECK STRIP BY
BARK BEETLES UP TO AND INCLUDING 1935.

	<u>Total</u>	<u>Per Acre</u>
Killed by <u>D.M.</u>	693	19.3
Killed by <u>Ips</u> & <u>D.m.</u>	129	3.6
Killed by <u>Ips</u> sp.	<u>984</u>	<u>27.3</u>
Total	1,806	50.2
Trees with green side following <u>D.m.</u> attack	22	.6
Trees which have "pitched- out" <u>D.m.</u> attack	75	2.1
Trees which have "pitched- out" <u>Ips</u> attack	<u>73</u>	<u>2.0</u>
Total	170	4.7
Grand Total	<u>1,976</u>	<u>54.9</u>

From the preceding table it can be seen that during the period of the outbreak on this strip more trees have been destroyed by secondary

insects than by the mountain pine beetle. In a much shorter time 72 percent as many trees have been killed by secondaries on this strip as on the Battlefield strip, whereas the mountain pine beetle has only killed 11.5 percent as many as on the Battlefield strip.

When the initial 1935 examination was made of the Elkhorn strip in May, a number of lodgepole pine from 1 to 4 inches in diameter were noted with fading foliage. No insect attacks were present within seven feet of the ground on these trees, but when a few were felled to determine the cause of fading they were found to be very heavily hit by secondaries in the upper portion. Only a few of the total number attacked showed fading foliage and detection of the insect work was impossible without felling or climbing the trees until it was found that a sharp blow of the hand axe well up on the bole dislodged enough boring dust from the upper infested portion of the trees to indicate the presence of insect work. These trees had been attacked late the preceding season but there was no indication of it when the final late October examination was made. Practically all of these top-killed trees were "filled-in" in the lower portion by secondary insects subsequent to the May 1935 examination.

Table VIII, which follows, gives the status of the stand on the Elkhorn strip up to the present time. Again we can note the concentration of mountain pine beetle attack on the larger-diameter trees. The following tabulation indicates the percent of each diameter class which has been attacked by bark beetles.

TABLE VIII
ELKHORN CHECK STRIP
STAND OF LODGEPOLE PINE PER ACRE
1935

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PERCENT OF LODGEPOLE ATTACKED BY BARK BEETLES IN
THE VARIOUS DIAMETER CLASSES UP TO 1935
ELKHORN CHECK STRIP-BEAVERHEAD NATIONAL FOREST

DBH												Average
Classes :	2	: 4	: 6	: 8	: 10	: 12	: 14	: 16	: 18	: 20	: 26	3.5
Percent :	*	:	*	:	:	:	:	:	:	:	:	
Attacked:	4.5	: 2.3	: 5.9	: 14.3	: 39.6	: 37.3	: 52.6	: 36.2	: 100	: 100	: 100	5.2

*Secondary insects responsible for the major part of the
loss in these classes.

Severe cold spells in 1932-33 and 1934-35, by preventing the infestation in the vicinity of the Elkhorn strip from following the normal increase and decrease, may decidedly influence the ultimate losses which will occur in that vicinity. No longer is there a great volume of insects to invade the area when they have exhausted the host material nearby. Furthermore, there has been a decided increase in the proportion of secondary insects which, as previously suggested, may be materially reducing the mountain pine beetle brood.

STATUS OF THE INFESTATION ON EACH UNIT

In previous years the status of the infestation on each unit has been discussed separately, but lack of data and the subsidence of the infestation over a large area make a continuance of such discussion superfluous. No mountain pine beetle infestation is believed to exist on the Pintlar, Mussigbrod, Battlefield, West Side, Jackson, and East Side Units. The remaining nine units all have less infestation than in 1934. The Bloody Dick, Horse Prairie, Lima, and Warm Springs Units will probably show

little if any infestation of the mountain pine beetle in 1936. The Grasshopper, Rattlesnake, Upper and Lower Wise River, and Melrose Units still have considerable timber of a size susceptible to insect attack which could support an infestation for a few more years. It remains to be seen what final effect the severe cold spells and the increase in the proportion of secondary insects will have on ultimate losses on these units. Other factors which may influence losses are the more broken nature of the stand, instead of continuous bodies of timber such as existed on the adjoining units to the west, and the presence of a larger proportion of unsusceptible timber species in the lodgepole stands.

No data were secured concerning the infestation on the Sheep Canyon Hills and on the Blacktail Creek Drainage. However, it is my belief that the outbreak in the Sheep Canyon Hills is declining owing to the same factors that reduced it in the Big Hole Basin--severe cold and a shortage of host material. In the Blacktail Hills there is still a great deal of host material, and only the cold spell of 1934-35 may have prevented a decided increase in the number of attacked trees on that area.

THE INFESTATION IN THE TOBACCO ROOT MOUNTAINS

It was decided to study the development of the mountain pine beetle infestation as it swept eastward into the Tobacco Root Mountains and the main Gallatin Forest. The Tobacco Root Mountain area is located about 35 miles east of the Melrose Unit of the Beaverhead Forest and includes slightly less than 300 square miles within the boundary of the three National Forests administering it. A great deal of the topography is rough,

rising from untimbered valleys on all but the south side, to peaks, some of which are more than 10,000 feet high. The southern boundary is ^{an} untimbered ridge connecting the Tobacco Root and Gravelly Ranges. Timber species vary from pure Douglas fir at the lower elevations, changing successively to lodgepole pine, whitebark pine, and finally to a mixture of the latter species with Engelmann spruce and alpine fir at high elevations.

The exact date when the mountain pine beetle infestation became established on the Tobacco Root area is not known, but judging from ranger reports it is believed to have been about 1928. Since that time much of the mature lodgepole pine and whitebark pine in the southwest portion of the Tobacco Roots has been killed. The northern and eastern portions have not been as heavily infested, and considerable susceptible material remains. However, about one-half the forested area on the northern part of the area is timber too small to be attacked by the mountain pine beetle.

The area has been divided according to the present forests administering it. The following tabulation gives the status of the infestation in 1934 and 1935.

THE MOUNTAIN PINE BEETLE INFESTATION IN THE
TOBACCO ROOT MOUNTAINS - 1934 and 1935

Name of Area	: Acreage:	: Number of Attacked Trees:		: Attacked Trees per Acre	
		1934	1935	1934	1935
Potosi-Gallatin	60,480	57,650	32,540	.954	.538
					(.272 WbP (.266 LP
Mill Creek-Beaverhead	60,480	245,890	223,960	4.066	3.703
					(3.052 WbP (.651 LP
Boulder River-Deerlodge	64,640	68,940	24,690	1.067	.382
					(.210 WbP (.172 LP
	185,600	372,480	281,190	2.007	1.515

It may be seen that there is considerable variation in the indicated decline of the infestation on the three units. This variation is believed to be due in the main to the small amount of data, but as only a general idea of the trend of the infestation is needed, the amount secured serves the purpose. The decline is believed to be due chiefly to the cold spell of 1934-35.

Unless a similar cold spell occurs in 1935-36, it is probable that an increase will occur in the Tobacco Root region during 1936, as there is still sufficient acceptable host material especially on the portion administered by the Gallatin Forest.

A check strip for the purpose of studying the progress of the mountain pine beetle infestation on the Gallatin Forest was established near the Squaw Creek Ranger Station in one of the largest bodies of timber on that forest. Although no mountain pine beetle work was noted on the strip, an active infestation was found about eight miles to the west across the Gallatin

River from the Squaw Creek Civilian Conservation Corps Camp.

SUMMARY

The outstanding findings of the 1934 survey were as follows:

1. The mountain pine beetle infestation no longer exists over the entire area draining into the Big Hole Basin of the Beaverhead Forest.

2. A decided decrease has occurred in the infestation on the remaining units of the Beaverhead Forest and in the Tobacco Root Mountain region.

3. There is evidence that secondary bark beetles have killed proportionately more trees each year since 1933, although the total dropped from 7,383,098 in 1934 to 4,395,093 in 1935.

4. The mountain pine beetle infestation has invaded the Gallatin River drainage near the Squaw Creek Ranger Station.

Respectfully submitted,



A. L. Gibson
Assistant Entomologist